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Hardwired Lighting

**California Building Energy Efficiency Standards
Revisions for July 2003 Adoption**

Hardwired Lighting

Description

This code and standards enhancement initiative will encourage the use of high efficacy light sources, occupancy sensors, photosensors, and/or tubular skylights in high-use areas of the home and exterior. This initiative also proposes to expand upon the current mandatory measures and to eliminate certain trade-off's in order improve energy efficiency while addressing low compliance rates, enforcement confusion, and unpopularity of the requirement with the design/build community. This initiative will apply to residential single-family and multifamily low-rise and high-rise construction.

Benefits

Requiring high-efficacy light sources in the high-use areas of the home has the potential to save up to 21 percent of home electrical energy use. Demand savings will also be realized, however the residential energy profile tends to peak at 7 to 8 PM in the summer after system-wide peak demand has passed. However, the recent winter energy crisis underscores the potential for the residential peak to be of greater significance when the residential peak is closer to the system-wide peak. Non-energy benefits of high-efficacy light sources include better lighting quality and reduced maintenance costs. Temperature dependent valuation would positively influence the effectiveness and benefits of this measure to the degree that lighting energy savings coincide with peak energy demand. The residential energy profile is lowest in the late morning when children are at school and begin to rise again in the afternoon when family members return from school and work.

Environmental Impact

The efficiency of compact fluorescent lamps depends upon a small amount of mercury vapor in each fluorescent tube. Increased use of compact fluorescent lamps has the potential to increase the presence of mercury in the environment and landfills in particular. However, the lighting industry is working to minimize the amount of mercury in fluorescent lamps and has an active recycling campaign. New lamp technologies include so-called "amalgam" materials instead of mercury, which reduce mercury content and increases lamp life.

Type of Change

In previous meetings, a lighting power density (prescriptive) approach to lighting efficiency for residential construction was eliminated from consideration because of its implementation complexities, added burden of development costs for the speculative home building market, and added plan-check burden for the local building departments. The current Title 24 mandatory measures require the use of high-efficiency sources in specific hardwired lighting fixtures. Trade-off's between rooms have been allowed or later introduced to address market considerations and cost implications of compact fluorescent luminaires. Now that they are becoming more widely available and have equal cost to incandescent luminaires, these trade-off's should be reevaluated for potential efficiency savings. Work will proceed to investigate strengthening the existing mandatory measures through changes to the hardwired lighting requirement, elimination of trade-off's between rooms, clarifying room definitions, requiring the use of motion sensors, photocells and/or timers and/or tubular skylights in specific areas of the home. The study will identify those rooms in the home where the current market structure indicates that improved lighting efficiencies can be achieved cost effectively and in a manner that is consistent and most easily enforced.

The proposed initiative may expand the scope of the standards to include a list of qualified tubular skylights. A performance standard for tubular skylights may need to be developed to quantify the visual and thermal energy implications of these devices. The initiative will increase use of the existing list of approved occupancy and photocell controls.

As a mandatory measure, the Residential Manual and the compliance forms would need to be updated accordingly.

Measure Availability and Cost

There is a thriving consumer market for the hardware for implementing the expanded scope of the revised mandatory measures. The three product categories affected by the measure include:

Luminaires: Boyd Lighting Fixture Company, Cooper Lighting, Day-Brite, Edison Price Lighting, Elliptipar, GE Lighting, Juno Lighting, Inc., Ledalite, Lightolier, Louis Poulsen Lighting, Philips Lighting, Prescolite, Ruud Lighting Inc., SPI Lighting Group, Sylvan Designs, Inc., Tech Lighting L.L.C.
Lighting controls: GE Lighting, Heath-Zenith, Leviton, Watt Stopper,
Tubular skylights: Solatube, Natural Light, Sun Tunnel, Sun Dome, Electroportal

There is not anticipated problem for these manufacturers to ramp up production to meet the increased demand for the products required for this measure.

The baseline product for comparison with interior compact fluorescent luminaire would be a 60-watt ceiling-mounted "globe" fixture with a white diffuser. The baseline product for comparison with exterior luminaires would be a 60-watt "bug lamp" fixture with a plastic diffusing globe. Alternatives for these products are readily available at marginal increased first cost and greatly reduce maintenance costs. No significant costs are associated with verification of the installation of these products.

Useful Life, Persistence and Maintenance

In the past, the persistence of energy efficient lighting for residential applications has been of great concern because of the widespread misconception that compact fluorescent lamps did not provide a very pleasing lighting environment. Past attempts to address this issue have required that all high-efficacy luminaires be designed to only accept bi-pin CFL lamps. After several years in the market, the opinion has begun to change and new technologies have improved the color, flicker, and durability of this product. Replacement lamp costs have come down to the \$3.00 to \$5.00 range with 5-year warranties when purchased in quantities of 4 at warehouse retail establishments. Homeowners have also become much more conscious of energy efficiency since the energy crisis of 2000-2001. It is therefore unlikely that there will be any problems with persistence of the measure. Lighting control products are typically designed to last 10-12 years without any maintenance. Tubular skylights are somewhat of an unknown because they have only begun to be widely used in the market for the past five years or so.

Performance Verification

There are no significant obstacles for performance verification or commissioning associated with this measure. As long as the product is properly installed, the developer and homeowner can easily manipulate any timing, aiming or sensitivity adjustments necessary to cause the product to behave in a reasonable manner.

Cost Effectiveness

So long as the specific areas for implementation of this measure are chosen carefully (i.e., are the high-use areas of the home), the cost effectiveness of the expansion of the high-efficacy luminaire and/or occupancy sensor requirement should be quite good. Exterior hardwired lighting fixtures have the greatest burn time and thus would show great cost effectiveness. The California Lighting Model (see Analysis Tools, below) will be used to demonstrate cost effectiveness. Since tubular skylights will be an alternate means of complying with the mandatory measure (instead of using an occupancy sensor on incandescent luminaires) the high cost of this product is of little significance.

Analysis Tools

The potential energy savings and peak electricity demand reductions will be analyzed with an updated version of the California Lighting Model (CLM). The CLM is used to assess the statewide energy impacts of various lighting efficiency

scenarios. The existing model may need to be updated with revised survey data to determine if the operation schedule of the residential occupancies has changed. Any assumptions in the model about market penetration may also need to be updated to reflect the current increased awareness of the importance of energy efficiency. No additional modeling or analysis tools will be required to document compliance with the modified mandatory measures.

Relationship to Other Measures

Other initiatives that may have relevance to the hardwired lighting mandatory measures include the Implementation of Standards initiative, the Multifamily initiatives, and the Forced Ventilation initiative. The Forced Ventilation initiative is considering tighter leakage requirements for recessed ceiling luminaires. It is important to consider any impact this additional requirement may have upon market conditions including the availability of qualifying luminaires.

Bibliography and Other Research

The following resources will provide the background for our proposed measure. These documents describe the lighting market as found in the mid-1990's. We anticipate that the findings of these documents will require only minor modifications to substantiate the efficiency claims of the proposed measure.

Lighting Efficiency Technology Report, Volume 1, California Baseline. California Energy Commission. May 30, 1997.

Lighting Efficiency Technology Report, Volume 2, Scenarios Report. California Energy Commission. September 1999.

Lighting Efficiency Technology Report, Volume 3, Market Barriers Report. California Energy Commission. September 1999.

Lighting Efficiency Technology Report, Volume 4, Recommendations Report. California Energy Commission. September 1999.

Residential Lighting Baseline. California Energy Commission. October 21, 1996.

An advisory committee made up of the contributors to the above documents (and others) will be formed and consulted throughout this development effort. We expect that any research currently underway or pertinent resources to consult will be identified during this process.